E3D Technical Challenges

Issue	Problem	Module	Approaches
1) Representation of shape & structure	Efficient representation of objects for matching; Efficient representation of objects by parts	Modeling	**Surfaces**: Facets, winged-edge, NURBS; **Solids**: Voxels, blocks, hyperquadrics, multires; **Parts**: Hierarchy
2) Representation of variability of structure	class models; models with variability; degrees of variability for	Modeling	Exemplars, Covariances of vertices; Grenander's Pattern Recognition Theory; Distributions of independent features
3) Capture of structure	Rapid insertion of models; on-the-fly model creation; Change detection	Modeling	Nonuniform sampling; occlusion reasoning; surface representation; parameter estimation; application of matching metrics

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4) Cues to targets in 3-D data	Use of 3-D environment to locate targets	Local area search	Paths of targets: Roads, evidence of off-road travel; Behavior: Groupings, convoys; Change detection; Novelty
5) 3-D properties of targets	Segment probable targets and environment from clutter; Detect decoys; Properties to uniquely identify vehicle	Clutter rejection; ID/Classify Fingerprinting	Measures of flatness, edges; detection of wheels, tracks; measures of detail; precise mensuration tools of gross features; determination of stores, attachments, dents
6) Algorithms for matching	Confidently, rapidly, match sensor data to 3-D model	ID/ Classify	Bayesian evaluation of observed data against modeled object variability